EFFECT OF PROTEIN ADSORPTION ON ELECTROCHEMICAL RESPONSES OF METAL ELECTRODES

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The development of an electrochemical bio-impedance sensor for the early detection of cervical cancer has been the motivation for our research. The interaction between proteins and solid surfaces occurs widely in nature and in artificial systems[1]. There has been extensive research into the mechanisms intrinsic to protein adsorption, particularly in the fields of biomaterials and biocompatibility. Adsorption of water, ions and biomolecules constitute the first events occurring at biomaterial-biosystem interfaces[2]. It is widely known that the adsorption of proteins onto electrode surfaces disturbs the electrochemical analysis of clinical samples. Such electrode fouling induces changes in the availability of electrode surface to analysis, resulting in modification of the electrochemical response[3]. Since a great deal of research is carried out in the field of analytical biochemistry, the understanding and elucidation of the effects of biological interaction with solid electrodes is of utmost importance.

The adsorption behavior and the subsequent effect on the electrochemical properties of gold and titanium dioxide electrodes have been investigated using radiolabelling (Iodine-125), cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). Human serum albumin (HSA) and Immunoglobulin G (Ig.G) were used as the test proteins. Adsorption under various electrochemical conditions as well as various protein solution compositions is been examined.

Protein adsorption occurs within the first few seconds of electrode-protein contact, and under the conditions used**,** is an irreversible process. This adsorbed protein layer was shown to act as a blocking agent, which hinders the electron transfer process occurring at the electrode/solution interface (figure 1). The rate at which this layer forms appear to be dependent on the protein solution pH as well as the potential applied during adsorption. Impedance spectroscopy showed a capacitance variation with adsorption (figure 2) that supports the results obtained from the CV work. Investigation of electrode behavior in protein solutions under rapid potential pulsing is currently underway and will be discussed.

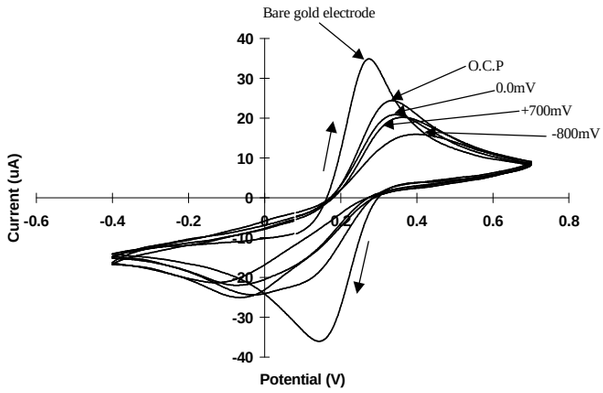

Figure 1. Cyclic voltammogram of bare gold disc electrode and HSA modified gold disc electrode in 0.01M $K_3Fe(CN)_6$/0.1M $NaNO_3$ solution. Adsorption of 100ppm (pH. 7.0) HSA for 5 minutes at the applied potentials listed. The arrows show the direction of the scan. Scan rate was 100mVs^{-1}.

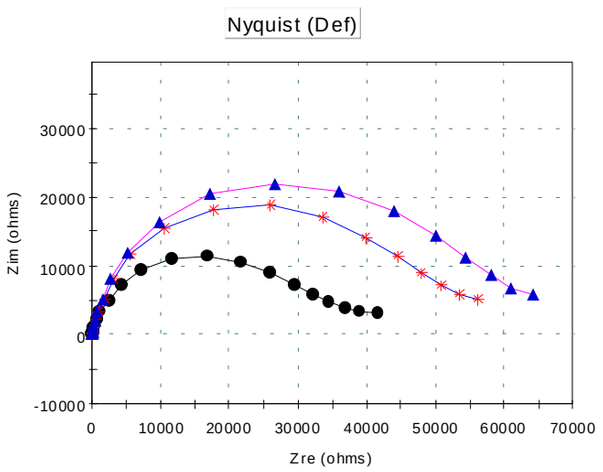

Figure 2. Nyquist spectra for various adsorption times. Impedance and adsorption was recorded in 1000ppm pH 7.0 Ig.G at -800mV. Adsorption times were 0 minutes (•), 15 minutes (∗) and 30 minutes (▲).

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